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Application For Reissue of
U.S. Patent No. 6,000,374

Inventor:	**James N. Usko et al.**
Filed:	**December 13, 2001**
For:	**MULTI-CYCLE, ENGINE BRAKING WITH POSITIVE POWER VALVE ACTUATION CONTROL SYSTEM AND PROCESS FOR USING THE SAME**
Attorney Docket #:	**34090-06263**

Commissioner for Patents
BOX REISSUE
Washington, D.C. 20231

Preliminary Amendment in Reissue Application

Dear Sir:

Pursuant to 37 CFR § 1.173, please amend the above-referenced reissue application, attached hereto, by deleting and/or adding text as indicated below:

IN THE BRIEF DESCRIPTION OF THE DRAWINGS:

Replace the paragraph beginning at column 12, line 10 with the following:

Fig. 4 is a plan schematic view illustrating the [dual cam] rocker arm arrangement and dedicated brake rocker for a compression release-type engine brake according to the present invention;

Delete the paragraph beginning at column 12, line 13.

Replace the paragraph beginning at column 12, line 15 with the following:

a2 Fig. 6 is a cross-sectional view of [the exhaust] a common rocker shaft [of Fig. 5 along section line I-I] and a solenoid valve according to one embodiment of the present invention;

Replace the paragraph beginning at column 12, line 17 with the following:

a3 Fig. 7 is a partial cross-sectional view of [the] an exhaust rocker arm [of Fig. 5 along section lines II-II and III-III] according to one embodiment of the present invention;

Replace the paragraph beginning at column 12, line 19 with the following:

a4 Fig. 8 is [a partial cross-sectional] an overhead view of [the] an exhaust rocker arm [of Fig. 7 along section line IV-IV] according to one embodiment of the present invention;

Delete the paragraph beginning at column 12, line 21.

Delete the paragraph beginning at column 12, line 23.

Replace the paragraph beginning at column 12, line 25 with the following:

a5 Fig. 11 is a partial cross-sectional view of [the] an intake rocker arm [of Fig. 10 along section lines V-V and VI-VI] according to one embodiment of the present invention;

Replace the paragraph beginning at column 12, line 27 with the following:

a6 Fig. 12 is a cross-sectional view of [the] an intake rocker arm [of Fig. 11 along section line VII-VII] according to one embodiment of the present invention;

Delete the paragraph beginning at column 12, line 29.

Replace the paragraph beginning at column 12, line 31 with the following:

a7 Fig. 14 is a partial cross-sectional view of [the] a brake rocker arm [of Fig. 13 along section line VIII-VIII] according to one embodiment of the present invention;

Delete the paragraph beginning at column 12, line 33.

Delete the paragraph beginning at column 12, line 35.

Delete the paragraph beginning at column 12, line 37.

Add the following paragraphs at column 12, line 43:

Fig. 19 is an enlarged cross-section view of a lash adjuster according to one embodiment of the present invention;

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Fig. 20 is a side view of an exhaust rocker arm according to an alternate embodiment of the present invention; and

Fig. 21 is a side view of an intake rocker arm according to an alternate embodiment of the present invention.

IN THE DETAILED DESCRIPTION OF THE INVENTION:

Replace the paragraph beginning at column 12, line ~~45~~ 50 with the following:

Reference will now be made in detail to a preferred embodiment of the present invention, an example of which is illustrated in the accompanying drawings. Fig. 4 and Fig. 18 illustrate a schematic view of the valve side of [dual cam shaft] a rocker arm arrangement and dedicated brake cam rocker for a compression release-type engine brake assembly **10** according to the present invention. The compression release engine brake components and the valve actuation components are located in rocker arms **100**, **200**, and **300**.

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Replace the paragraph beginning at column 12, line ~~54~~ 59 with the following:

a10 sub c1

The rocker arms **100**, **200**, and **300** are spaced along a common rocker shaft **11** having at least one passage. The common rocker shaft **11** has a passage **12** through

which a supply of engine oil flows therethrough, as shown in Fig. 6. The common rocker shaft **11** also has a supply passage **13** which supplies hydraulic fluid to an exhaust rocker arm **100** and an intake rocker arm **200**. A valve **30** is located on the common rocker shaft **11**, as shown in Fig. 6. The valve **30** is preferably a normally open solenoid valve, as shown in Fig. 6. It, however, is contemplated by the inventors of the present invention that other suitable valves may be substituted and are considered to be within the scope of the present invention. The valve **30** includes a connector assembly **31** for electrically connecting the valve **30** to a vehicle voltage source[, not shown]. The valve **30** when in an open position permits the flow of hydraulic fluid from passage **12** to supply passage **13**. The rocker arms **100**, **200** and **300** correspond to a cam shaft **20** having three spaced cam lobes **21**, **22**, and **23**. Exhaust cam lobe **21** corresponds to an exhaust rocker arm **100**, as shown in Fig. 7. Intake cam lobe **22** corresponds to an intake rocker arm **200**, as shown in Fig. 11. Brake cam lobe **23** corresponds to a brake rocker arm **300**, as shown in Fig. 14. The exhaust cam lobe **21** and the intake cam lobe **22** are oriented and timed to effect normal valve operation, as in a typical four-stroke internal combustion engine, of the type known in the prior art.

Replace the paragraph beginning at column 13, line 17 with the following:

The brake cam lobe **23** includes a first compression release lobe. In a preferred embodiment, as shown in Fig. 3, the [profile of the lobe starts at about 35°. The] first compression release [lobe] event **1** is timed to start at about 40° before compression top dead center (TDC), then reach maximum opening around compression top dead center.

The first compression release event is timed to then [Then] start closing after compression top dead center, staying partially open for a period, as shown by the exhaust gas recirculation event **2**, and then closing around bottom dead center[,]. [and finish just after compression TDC.] A second [lobe] compression release event **3** is timed to start about [1000] 40° before exhaust TDC [after compression TDC] and finish by [200°] 70° after [compression] exhaust TDC.

Replace the paragraph beginning at column 13, line 28 with the following:

Means for effecting exhaust valve operation will now be described in connection with Figs. [5-9] 7 and 8. The means includes an exhaust rocker arm **100** that is rotatably mounted on the common rocker shaft **11**. A first end of the exhaust rocker arm **100** includes an exhaust cam lobe follower **110**. The exhaust cam lobe follower **110** preferably includes a roller follower **111** that is in contact with the exhaust can lobe **21**.

Replace the paragraph beginning at column 13, line 35 with the following:

A second end of the exhaust rocker arm **100** has a lash adjuster **120**. The lash adjuster **120** is adjacent to a crosshead **130**. The lash adjuster **120** is described in detail below. The crosshead **130** is preferably a bridge device that is capable of opening two exhaust valves simultaneously. The exhaust rocker arm **100** also includes a control valve **140** that includes a spring ball assembly **141**, as shown in Fig. 8. The control valve **140** is in communication with a fluid passageway **150** that extends through the exhaust rocker arm **100** to the lash adjuster **120**. The control valve **140** is also in

communication with a fluid passageway **160** that extends between the control valve **140** and supply passage **13** of the common rocker shaft **11**, as shown in Fig. 7.

Replace the paragraph beginning at column 13, line 48 with the following:

The passage **12** is connected to passage **14** which supplies hydraulic fluid to provide lubrication between the exhaust rocker arm **100** and the common rocker shaft **11**. The passage **14** also supplies lubricant through passage **15** to the exhaust cam lobe follower **110** such that the exhaust roller follower **111** [smoothly follows cam **21**] is lubricated.

Replace paragraph beginning at column 13, line 54 with the following:

Means for effecting intake valve operation will now be described in connection with Figs. [10-12] 11 and 12. The means includes an intake rocker arm **200** that is rotatably mounted on the common rocker shaft **11**. A first end of the intake rocker arm **200** may include an intake cam lobe follower **210**, as described above in connection with exhaust rocker arm **100**. The intake roller follower **211** of the intake cam lobe follower **210** is in contact with the intake cam lobe **22**. However, it is contemplated that other cam followers[, such as, for example, a roller follower] are considered to be within the scope of the present invention.

Replace the paragraph beginning at column 13 line 64 with the following:

A second end of the intake rocker arm **200** has a lash adjuster **220**. The lash adjuster **220** has the same design as the lash adjuster **120** described above in connection with the exhaust[er] rocker arm **100**. The lash adjuster **220** is adjacent to a crosshead **230**. The lash adjuster **220** is described in detail below. The crosshead **230**

is also preferably a bridge device that is capable of opening two intake valves simultaneously. The intake rocker arm **200** also includes a control valve **240**. The control valve **240** is in communication with a fluid passageway **250** that extends through the exhaust rocker arm **200** to the lash adjuster **220**, as shown in Fig. 12. The control valve **240** has the same construction as the control valve **140** described above in connection with the exhaust rocker arm **100**. The control valve **240** is also in communication with a fluid passageway **260** that extends between the control valve 240 and supply passage 13 of the common rocker shaft **11**, as shown in Fig. 11.

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Replace the paragraph beginning at column 14, line 14

The passage **12** is connected to passage [15] **16** which supplies hydraulic fluid to provide lubrication between the [exhaust] intake rocker arm **200** and the common rocker shaft **11**. The passage [14] **16** also supplies lubricant through passage [17] **25** to the [exhaust] intake cam lobe follower **210** such that the intake roller follower **211** [smoothly follows cam **22**] is lubricated. Alternatively, the common rocker shaft **11** may be provided with a third passage **18**, as shown in Fig. 18. The third passage **18** supplies lubricant to the cam lobe [following] followers **110**, **210** and **310**.

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Replace the paragraph beginning at column 14, line 23 with the following:

Means for effecting two cycle engine braking will now be described in connection with [Figs. 13-15] Fig. 14. The means includes a brake rocker arm **300** that is rotatably mounted on the common rocker shaft **11**. A first end of the brake rocker arm **300** includes a brake cam lobe follower **310**. The brake cam lobe follower **310** preferably includes a roller follower **311** that is in contact with the brake cam lobe **31**.

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Replace the paragraph beginning at column 14, line 30 with the following:

A second end of the brake rocker arm **300** has an actuator piston **320**. The actuator piston **320** is spaced from the crosshead pin 133 of the crosshead **130** [of the exhaust rocker arm **100**]. When activated, [the brake rocker arm 300 and] the actuator piston **320** contacts the crosshead pin **133** of the crosshead **130** to open the at least one exhaust valve. The brake rocker arm **300** also includes a combination control valve/solenoid valve **340**. The valve **340** is in communication with a fluid passageway **350** that extends through the brake rocker arm **300** to the actuator piston **320**, as shown in Fig. 14. The valve **340** is also in communication with a fluid passageway **360** that extends between the valve **340** and passage **12** of the common rocker shaft **11**. The valve **340** [is] preferably includes an electronically operated solenoid valve **344**. The valve **340** includes a connector assembly **341** for electrically connecting the [control] solenoid valve **344** to a vehicle -- which supplies voltage at the proper time.

Replace the paragraph beginning at column 14, line 47 with the following:

The above-described brake rocker arm **300** includes [a] the valve **340** [including a solenoid valve] mounted [on the rocker arm 300] thereon. It is contemplated and preferred by the inventors of the present invention that the solenoid valve **344** of the valve **340** may be relocated to the common rocker shaft **11**. As shown in Fig. 18, solenoid valve **344** is located on the common rocker shaft **11**. With this arrangement, any difficulties with electrically connecting the valve to the vehicle are avoided because the solenoid valve **344** would not rotate with the rocker arm. The brake rocker arm **300** would include a control valve **342** therein similar to control valves **140** and **240**,

described above. Hydraulic fluid would then be fed to the rocker arm **300** through the solenoid valve **344** on the common rocker shaft **11** to the control valve **342** on the rocker arm to operate the actuator [portion] piston **320**.

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Replace the paragraph beginning at column 15, line 6 with the following:

The lash adjuster **120** will now be described in connection with Fig. [9] 19. The lash adjuster **120** is mounted in the second end of the exhaust rocker arm **100**, as shown in Fig. [9] 19. The lash adjuster **120** includes an inner plunger **121** and an outer plunger **122**. The outer plunger **122** includes a ring **1221** that is positioned within groove **170** within the exhaust rocker arm **100**, as shown in Fig. [9] 19. The inner plunger **121** is slidably received within the outer plunger **122**. In operation, hydraulic fluid flows into a cavity **1211** in the inner plunger **121**. As the cavity **1211** fills with fluid, the check ball valve **1213** is biased downwardly to open aperture **1210** in the inner plunger **121**. Hydraulic fluid then flows into cavity **1222** [in] between the outer plunger **122** and the inner plunger **121**. As the cavity **1222** is filled with fluid, the outer [piston] plunger [121] **122** moves downward to an extended position to engage crosshead [pin] **130**. The downward movement of the outer [piston] plunger [121] **122** is limited by the ring **1221** engaging the lower surface of groove **170**.

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Replace the paragraph beginning at column 15, line 37 with the following:

sub c2

Fig. 3 depicts the exhaust valve opening and remaining open for optimum engine braking. As shown in Fig. 3, the motion begins [at the] before the TDC of the first compression stroke. Additionally, the extended plateaus shown during which the exhaust valve remains open but with a reduced valve opening, permits drawing exhaust

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gas from the exhaust manifold into the cylinder as the piston travels away from the cylinder head. The exhaust valve closes and the entrapped exhaust gas is compressed and then released providing a second engine braking cycle **3**. The motion of the intake valve will now be described. [Subsequently, the intake valve opens, air is drawn into the cylinder and compressed and then released providing a first engine braking cycle. Subsequently, the intake valve opens, air is drawn into the cylinder and compressed repeating the two-cycle braking.] The intake valve's opening **4** is modified (from its positive power timing **8**) to occur after TDC of the second braking cycle **3** to insure the compressed exhaust gas is not vented into the intake manifold.

Replace the paragraph beginning at column 15, line 55

The operation of the exhaust rocker arm **100** will now be described during positive power operation. During positive power, the [control] valve **30** is opened. The [control] valve **30** is preferably a normally open three way solenoid valve. The solenoid valve **30** permits the flow of hydraulic fluid from passage **12** to supply passage **13**. Fluid then flows through passageway **160** to control valve **140**. The spring ball assembly **141** of the control valve **140** is unseated to allow hydraulic fluid to flow through passageway **150** to lash adjuster **120**. The lash adjuster **120** is extended to a fully extended normal operating position such that the lash adjuster **120** is in contact with the crosshead **130**. When pressure within the control valve **140**, specifically the spring ball assembly **141** equalizes a hydraulic lock forms which allows the lash adjuster **120** to remain in an extended position. Accordingly, the exhaust rocker arm **100** will activate exhaust valve openings in response to exhaust cam lobe **21**.

Replace the paragraph beginning at column 16, line 8 with the following:

The operation of the intake rocker arm **200** during positive power operation will now be described. As described above in connection with the exhaust rocker arm **100**, the solenoid valve **30** is in an open position. The [spring ball assembly 241 of] solenoid valve **30** permits the flow of hydraulic fluid from passage **12** to supply passage **13**. Fluid then flows through passageway **260** to control valve **240**. The spring ball assembly **241** of the [The] control valve **240** is unseated to allow hydraulic fluid to flow through passageway **250** to lash adjuster **220**. The lash adjuster **220** is extended to a fully extended normal operating position such that the lash adjuster **220** is in contact with the crosshead **230**. The control valve **240** operates in a similar manner to control valve **140**, described above, to form a hydraulic lock that allows the lash adjuster **220** to remain in an extended position. Accordingly, the intake rocker arm **200** will actuate intake valve openings in response to intake cam lobe **22**.

Replace the paragraph beginning at column 16, line 25 with the following:

The operation of the brake rocker arm **300** during positive power operation will now be described. The [solenoid] valve **340** is closed. During positive power, the solenoid valve **344** of the valve **340** remains closed. Accordingly, the actuator piston **320** remains in a [seated] retracted position, as shown in [Figs. 14 and 15] Fig. 14. The brake rocker arm **300** will remain in a disabled position during positive power.

Replace the paragraph beginning at column 16, line 35 with the following:

The operation of the exhaust rocker arm **100** will now be described during an engine braking operation. During engine braking, the solenoid valve **30** is operated to stop the

flow of hydraulic fluid through passage **13**. The control valve **140** is [opened] in the off position. This permits the hydraulic fluid trapped within passageway **150**, as described above in connection with the positive power operation to be vented[.], [The spring ball assembly 141] [prevents] preventing the additional supply of hydraulic fluid to passageway 150. This causes the lash adjuster **120** to retract. As a result, exhaust valve openings cease during the engine braking operation. A spring, not shown, may be provided to prevent vibration and chatter of the exhaust rocker arm **100** when in the above described disabled position.

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Replace the paragraph beginning at column 16, line 50 with the following:

The operation of the intake rocker arm **200** will now be described during an engine braking operation. During engine braking, the solenoid valve **30** is operated to stop the flow of hydraulic fluid through passage **12**, as described above. A control valve **240** is operated to vent the hydraulic fluid in a similar manner as described above in connection with the exhaust rocker arm **100**. The preset stop of the lash adjuster **220** prevents the lash adjuster **220** from fully retracting. Accordingly, the intake rocker arm **200** is not fully disabled during the engine braking operation. The total cam lift of the intake cam lobe **22** is not transferred into valve lift. This has the effect of delaying the time event to occur after exhaust top dead center. The opening of the intake valve is delayed due to the partially retracted position of lash adjuster **220**. The opening is delayed until the cylinder is vented through the open exhaust valve immediately following the second compression braking cycle **3**, as shown in Fig. 3.

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Replace the paragraph beginning at column 17, line 1 with the following:

The operation of the brake rocker arm **300** during an engine braking operation will now be described. During engine braking, the [solenoid] valve **340** is operated. Hydraulic fluid is permitted to flow from passage **12** through passageway **360** to passageway **350**. The actuator piston **320** then extends to a fully extended position such that it contacts pin **133** on crosshead **130**. When the passageway **350** is filled with hydraulic fluid and the pressure is equalized within valve **340**, a hydraulic lock is formed thus holding the actuator piston **320** in an extended position. The operation of the exhaust valve is now controlled by the brake rocker arm **300** in response to actuation by the brake cam lobe **23**. The operation of the exhaust valves will occur in response to the profile of the brake cam lobe **23**.

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Replace the paragraph beginning at column 17, line 54 with the following:

Continuing with the embodiments in the accompanying figures, Fig. [16] 20 is an alternative embodiment for the means for effecting exhaust valve operation. The exhaust rocker arm **1000** is rotatably mounted on the common rocker shaft **11**. A first end of the exhaust rocker arm **1000** includes an exhaust cam lobe follower [110] **111**.

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Replace the paragraph beginning at column 17, line 60 with the following:

A second end of the exhaust rocker arm **1000** has a lash adjuster **120**. The lash adjuster **120** is connected adjacent to a crosshead **130**. The crosshead **130** is preferably a bridge device that is capable of opening two valves simultaneously. The exhaust rocker arm **1000** also includes a combination control valve/solenoid valve **1400**. The [solenoid control] valve **1400** is in communication with a fluid passageway **150** that extends through the exhaust rocker arm **100** to the lash adjuster **120**. The [solenoid

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control] valve **1400** is also in communication with a fluid passageway [160] **16** that extends between the [solenoid] valve [140] **1400** and supply passage 13 of the common rocker shaft **11**. The [solenoid] valve **1400** combines the solenoid valve **30** and the [solenoid] control valve **140** into a single assembly.

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Replace the paragraph beginning at column 18, line 7 with the following:

Fig. [17] 21 is an alternative embodiment for the means for effecting intake valve operation. The intake rocker arm **2000** is rotatably mounted on the common rocker shaft **11**. A second end of the intake rocker arm **2000** has a lash adjuster **220**. The intake rocker arm **2000** also includes a combination control valve/solenoid valve **2400**. The [solenoid] valve **2400** is in communication with a fluid passageway **250** that extends through the exhaust rocker arm **2000** to the lash adjuster **220**. The solenoid valve **2400** has the same construction as the [solenoid] valve **1400** described above in connection with the exhaust rocker arm **1000**.

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Replace the paragraph beginning at column 18, line 22 with the following:

It will be apparent to those skilled in the arts that various modifications and variations can be made in the construction and configuration of the present invention, without departing from the scope or spirit of the invention. Several variations have been discussed in the preceding text. Furthermore, it is contemplated that the present invention may be used with a common rail camless type engine whereby the above described [rocker arms] engine valves may be electronically operated. Others will be apparent to persons of ordinary skills in the art. It is intended that the present invention

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